National Ignition Facility & Photon Science

NIF *By the Numbers*

The National Ignition Facility (NIF) became operational in March 2009. Planning began in the early 1990s and ground was broken for the facility on May 29, 1997—12 years to the day before NIF's dedication.

Construction

Construction of the main NIF building, known as the "conventional facility," was completed in 2001.

- Building height: 10 stories
- Building area: 3 football fields
- Cubic meters of soil excavated: over 160,000
- Cubic meters of concrete poured: over 55,000
- Tons of reinforcing steel rebar installed: 7,600
- Tons of structural steel erected: about 5,000
- Hours of craft labor worked: more than 1.7 million

NIF optics

- NIF's total optical surface area is three-quarters of an acre—40 times the surface area of the giant Keck telescope in Hawaii.
- Number of large (meter-sized) optics: 7,500
- Number of small optics: more than 26,000
- Length of NIF laser glass if stacked end-to-end: 1.5 miles
- Time to grow NIF crystals using traditional techniques: up to 2 years
- Time to grow crystals using LLNL-developed rapid-growth process: 2 months

Target Chamber

The NIF Target Chamber was installed in June 1999.

- Weight: 130 metric tons (287,000 pounds)
- Diameter: 10 meters (33 feet)
- Exterior material: Welded aluminum covered by 1 foot of neutron-absorbing concrete
- Interior wall: Stainless-steel louvers
- Capacity of installation crane: 900 tons
- Trucks required to transport crane from Nevada Test Site: 66

Target Bay

The Target Bay houses the final optics assemblies, diagnostics, and the Target Chamber.

- Height: 30 meters (98 feet)
- Diameter: 30 meters
- Material: Reinforced concrete
- Wall thickness: 2 meters (6.5 feet)

Laser Bays

NIF's laser bays, switchyards, and target area form the largest cleanroom in the nation.

- Laser Bay 2 commissioned: August 2007
- Laser Bay 1 commissioned: September 2008
- Number of laser beams: 192
- Length of laser bays: 122 meters (400 feet)
- Number of amplifier glass slabs: over 3,100
- Number of flashlamps: 7,680
- Number of line replaceable units (mechanical housings that hold the lenses, mirrors, and utilities): 6,206

Lasers

NIF's laser pulses are generated by an optical fiber laser called the master oscillator.

- Duration of laser pulse: up to 30 billionths of a second
- Length of nominal laser pulse: 6.1 meters (20 feet)
- Total distance of pulse travel from master oscillator to target chamber: 1,500 meters (4,900 feet)
- Duration of pulse travel: about 5 millionths of a second
- Initial laser energy: 1 billionth of a joule
- Laser amplification: 20,000 billion times
- Infrared laser energy at full power: 4.8 megajoules (million joules)
- Ultraviolet laser energy at full energy: more than 1.8 megajoules
- Ultraviolet peak power: 500 trillion watts
- The Advanced Radiographic Capability inside NIF is the world's most energetic short-pulse laser: 6 kilojoules

Control & Data Systems

The NIF Control Room, housing the Integrated Computer Control System, is modeled on NASA's Houston Control Room and designed for a scientific machine. A suite of sophisticated applications and infrastructure manage every NIF experiment from proposal, scheduling, component inventories, experiment definition, system re-configuration, shot cycle execution, and data archiving and analysis.

- Parameters to define a NIF experiment: about 18,000
- Computer controlled devices: about 66,000
- Software operations per shot: about 2 million
- Control system computers: about 2,500
- Lines of code: 13.5 million

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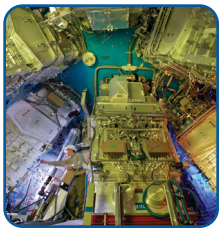

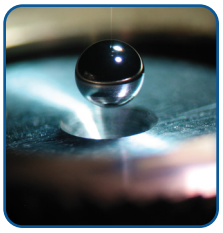

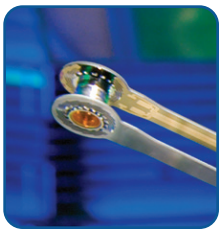

- Beam alignment tolerance on target: 50 microns (millionths of a meter)
- Beam timing tolerance on target: 30 trillionths of a second
- Data records archived per shot: about 15,000
- Unique archived data records: about 20 million

Diagnostics

NIF has 107 total target diagnostic systems including 37 nuclear, 13 optical and 57 x-ray diagnostics. Target diagnostics measure everything between the fundamental laser wavelength, 1,052 microns (millionths of a meter), and 14-million-electron-volt neutrons.

- Channels of data recorded on any given experiment: 652
- Deuterium-tritium burn history measured: within a few trillionths of a second
- Diagnostic capabilities added per year: about a dozen

US and Global Industry Participation

- Purchased from outside industry: more than $60 million per year
- Total suppliers: more than 400
- States represented: more than 40
- Valued California industry suppliers—among those most frequently engaged (about $100,000 per year and up): more than 60
- Purchased from U.S. small/woman/veteran/minority-owned businesses: more than $12 million per year
- U.S. small and woman/veteran/minority-owned suppliers: more than 200

Targets

NIF targets are designed and machined to meet the needs of many different experiments.

- Hohlraum material: gold or depleted uranium
- Target capsule material: beryllium, plastic, or high-density carbon (diamond)
- Hohlraum length: about 9 millimeters
- Hohlraum diameter: 5 millimeters
- Target capsule diameter: 2 millimeters
- Target fill tube diameter: 2-10 microns
- Construction tolerance (density, concentricity, and surface smoothness): nanometer to several microns

Fusion Fuel

NIF's fuel consists of deuterium and tritium, two forms of hydrogen with one or two extra neutrons.

- Temperature prior to compression: 18 kelvins (-427 degrees Fahrenheit)
- Temperature at ignition: 100 million kelvins (180 million degrees Fahrenheit—more than six times hotter than the core of the sun
- Pressure at ignition: More than 100 billion atmospheres
- Density at ignition: Up to 100 times the density of lead

Power Conditioning System

NIF's high-voltage capacitors are charged for about 60 seconds before releasing their energy.

- Total stored energy: 400 megajoules—the world's largest capacitor bank
- Length of energy burst: 400 microseconds (millionths of a second)
- Electrical system peak power: more than 1 trillion watts
- Total length of high-voltage cable: More than 305 kilometers (about 190 miles)

Switchyards

After amplification in the laser bays, the NIF beams enter the switchyards, where they are redirected by turning mirrors to the Target Chamber.

- Height of switchyards: 30 meters (98 feet)
- Tons of steel in switchyard space frame structures: 1,000
- Thickness of reinforced concrete walls: 0.6 meters (2 feet)

Heating, Ventilation and Air Conditioning

More than 30 large HVAC systems maintain the building at a constant temperature to within 0.25 degrees to maintain laser pointing; pointing accuracy is equivalent to pitching a baseball from San Francisco and throwing a strike in Los Angeles ■

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